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International Commodity Markets

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On the Relevance of World Agricultural Prices

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and
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Is it appropriate for market analysts to use international agricultural prices as a proxy for domestic prices when domestic prices are unavailable? A firm yes.

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International Commodity Markets

This paper — a product of the International Commodity Markets Division, International Economics Department — is part of a larger effort in PRE to model the global markets for primary commodities and to use these models for forecasting purposes as well as for policy analysis. Copies are available free from the World Bank, 1818 H Street NW, Washington DC 20433. Please contact Dawn Gustafson, room S7-044, extension 33714 (30 pages with tables).

In a free market, domestic prices on agricultural products could be expected to vary with world prices. But intervention is so common with agricultural products that prices vary between countries and gaps exist between world and domestic prices.

The International Commodity Markets Division is often forced to use international prices as a proxy for domestic prices. But it is often claimed that world prices are irrelevant to agricultural development in countries that intervene in agricultural pricing.

Mundlak and Larson examined the appropriateness of this substitution in measuring, say, the agricultural supply response to price changes — particularly in the long run.

They conclude that on the whole world prices are indeed relevant. The results — for 18 countries and 17 commodities — are surprisingly robust, and invariant to both data sources and time/commodity pooling.

Produced at the PRE Dissemination Center

Foreword

In the absence of domestic prices for primary commodities the International Commodity Markets Division is often forced to use international prices as a proxy for domestic prices. This project examines the appropriateness of using international prices, say in measuring agricultural supply response to price changes — particularly in a long-run context. This project is part of the Division's program of research on commodity price behavior and supply responsiveness in agriculture.

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ON THE RELEVANCE OF WORLD AGRICULTURAL PRICES *

by

Yair Mundlak and Don Larson

Introduction

1. Agricultural products are on the whole tradables and every country trades in some agricultural products. In the absence of intervention it is expected that domestic prices of such products will vary with world prices. However, it is well known that agriculture is subjected to considerable intervention which creates a gap between world and domestic prices, and generates cross-country variations in agricultural prices. Therefore, it is often claimed that world prices are irrelevant for the development of agriculture in countries which intervene in the pricing of their agricultural products.

* The authors are grateful to Ronald C. Duncan and D.G. Johnson for comments and suggestions on an earlier draft.

2. It is true that intervention affects the relationship between domestic and world prices. Interventions in agriculture are well documented and it is rare to find a country which does not intervene (see for example, McCalla, 1969; Johnson 1973; Bale and Lutz, 1981; Australian Bureau of Agricultural Economics, 1985; Anderson, Hayami and Honma, 1986; World Bank 1986). The discussion on intervention deals primarily with the effect of policies on domestic prices and the consequences for domestic production, consumption trade, welfare and the spill over to the world market. Such policies are costly and therefore the reasons for their implementation are discussed as well. There are basically two approaches to the reasoning of government policies. The first one considers policy to be endogenous within the economic system. Examples of this approach are: Bullock, 1989; Rausser and Freebairn, 1974; Rausser and Stonehouse, 1978; Shei and Thompson, 1977. The second one treats policies within a broad framework where political pressures play a dominant role and therefore the response of government to changes in the economy are strongly hindered by political considerations. Examples of this approach to agricultural policy are: Abler, 1987; Gardner, 1987; Miller, 1986; Binswanger and Scandizzo, 1983.

3. In this paper we ask a different question; to what extent are world prices transmitted to domestic prices? This is a crucial topic for understanding the relationships between domestic and world markets. It is of particular interest in studying the dynamics of world agriculture (Mundlak, 1989).

4. The insulation of a country from world prices requires resources. As the gap between domestic and world prices increases, the cost of such policies increases accordingly and eventually becomes excessive. Hence, it leads one to believe that the gap is bounded and if this is the case then we should see a transmission of world prices to domestic prices. This is the working hypothesis to be tested in this paper. Its implication is discussed in the concluding section.

The Framework

5. The simple framework draws on the (relative) law of one price where the domestic price, P, is expressed as a product of the world price, P^*, the nominal exchange rate, E, and the tax policy S = (1+t), where t is the tax rate.

$$P = P^*ES \tag{1}$$

This formulation assumes that the product is homogeneous in that world and domestic prices refer to the same product; marketing margins and other domestic non-tradable inputs are ignored. This is an unrealistic assumption and any interpretations should be modified accordingly. We return to this below. At present it is assumed that the systematic components of the non-tradable inputs are confounded in E and S whereas a disturbance U is added to account for the transitory component. Rewriting (1), with lower case letters indicating logs, we have for commodity i in year t:

$$p_{it} = p^{*}_{it} + e_{t} + s_{it} + u_{it}. \qquad (2)$$

Let the relative difference in prices be $d = p - p^{*}$ and refer to $z = e + s$ as the policy variable, then

$$d_{it} = z_{it} + u_{it}, \qquad (2')$$

where $u \sim (0, \sigma^{2})$, and $E(zu) = E(p^{*}u) = 0$.

6. Given the stochastic identity (2'), the elasticity of domestic prices with respect to world prices depends on the relationship between z and p*, z(p*). For example, where government actions reduce fluctuations in world prices $z'(p^{*}) < 0$. At this point, we introduce the linear (in parameters) version for z(p*) and refer to it as the policy equation:

$$z_{it} = \pi_{o} + \pi p^{*}_{it} + v_{it}, \text{ where } E(p^{*}v) = 0. \qquad (3)$$

7. The empirical relationship between domestic and world prices is given by the regression coefficient of p on p*, referred to as the elasticity of domestic price with respect to world price:

$$b = \Sigma\Sigma\, p_{it}p^{*}_{it} \,/\, \Sigma\Sigma\, p^{*2}_{it} \qquad (4)$$

and by the correlation coefficient of the two prices. The summation in (4) is over commodities and time and the variables are measured as deviations from their overall means. As explained below, the variables are unitless.

Using (3), the expected value of b is evaluated:

$$E(b - 1) = E(\Sigma\Sigma\, d_{it}\, p^{*}_{it} \,/\, \Sigma\Sigma\, p^{*2}_{it}) = \pi \qquad (5)$$

8. When the policies are independent of the world prices, b will be nearly 1. On the other hand, b is smaller than 1 when the policies reduce the fluctuations in world prices and larger than 1 in the opposite case. The closer b is to 1, the more closely domestic prices reflect, on average, world prices. The quantitative importance of world prices in the determination of domestic prices is measured by the contribution of p* to the variations in p. This is represented by the degree of fit, (R^2), of the regression of p on p*.

Empirical Results

Data

9. The elasticity parameter b was estimated for 58 countries for the period 1968-78; the sample covered some 60 products. The number of products varied by countries. Products not produced in a country were excluded from the analysis.

10. The domestic prices are FAO prices described by FAO as:

"Farm prices are in theory determined by farm gate or first point-of-sale transaction when farmers participate in their capacity as

sellers of their own products. Of course, data may not always refer to the same selling points depending on the prevailing institutional set-up in the countries. Also different practices may prevail in regard to individual communities." 1/

11. The domestic prices are converted from local currencies to US dollars using exchange rates (annual averages) published by the IMF. The world price is an export unit value calculated in nominal US dollars. It is a ratio of the total world value of exports for each of the commodities divided by the total world exported quantities for the corresponding commodities.

12. Note that in this study the domestic prices are expressed in US dollars, or as P/E in terms of (1). However, there may be a difference between the exchange rate used in converting prices from domestic currencies to dollars and between the "true" rate. Therefore E in (1), or e in (2) is viewed as a correction factor for the exchange rate and is unitless. With this interpretation, the policy variable z is unitless. It represents the proportional deviation of domestic prices from world prices. Also, note that the deviations of p^*_{it} from their mean ($p^*..$) are unitless. They simply represent the log of the proportional change in prices.

1/ FAO Production Yearbook, 1987.

Table 1: ELASTICITY OF PRODUCER PRICE WITH RESPECT TO WORLD PRICES

COUNTRY	POOLED	WITHIN			BETWEEN	
		i	t	it	i	t
Argentina	0.966	0.759	0.990	0.551	1.000	0.794
Australia	0.930	0.847	0.933	0.486	0.944	0.907
Austria	0.979	0.790	0.991	0.106	1.009	0.902
Bangladesh	0.715	0.630	0.710	0.074	0.731	0.748
Belgium-Lux.	0.972	0.824	0.981	0.290	0.997	0.929
Brazil	0.902	1.097	0.847	0.316	0.865	1.268
Burundi	0.862	0.579	0.884	0.128	0.901	0.667
Cameroon	0.890	0.865	0.867	0.147	0.894	1.030
Canada	0.999	0.797	1.018	0.316	1.033	0.8[illegible]
Chile	0.878	0.641	0.920	0.490	0.929	0.67[illegible]
Colombia	0.922	0.648	0.944	0.017	0.972	0.[illegible]
Costa Rica	0.908	0.659	0.933	0.417	0.946	0.[illegible]
Cyprus	0.925	0.831	0.927	0.425	0.942	0.900
Denmark	1.037	0.944	1.033	0.208	1.055	1.080
Ecuador	0.987	0.719	1.012	0.244	1.036	0.816
Egypt	1.208	0.964	1.231	0.123	1.271	1.102
El Salvador	0.903	0.759	0.904	0.213	0.926	0.891
Finland	0.967	0.636	0.998	-0.051	1.023	0.789
France	0.949	0.846	0.951	0.340	0.967	0.930
Germany F.R.	0.989	0.751	1.001	0.183	1.024	0.902
Greece	0.912	0.846	0.908	0.208	0.925	0.948
Guatemala	0.907	0.697	0.924	0.309	0.940	0.799
India	0.737	0.438	0.775	0.173	0.795	0.503
Ireland	1.022	0.809	1.033	0.150	1.050	0.934
Israel	0.972	0.798	0.995	0.397	1.010	0.877
Italy	0.909	0.690	0.942	0.296	0.960	0.754
Japan	0.942	1.142	0.883	-0.008	0.909	1.347
Kenya	1.064	0.750	1.091	0.294	1.112	0.858
Korea, Rep.	0.921	0.997	0.894	0.231	0.910	1.097
Malawi	0.888	0.488	0.923	-0.057	0.950	0.607
Malaysia	0.858	0.836	0.846	0.358	0.862	0.958
Mauritius	1.041	0.989	1.033	0.378	1.048	1.117
Mexico	0.985	0.654	1.036	0.373	1.055	0.724
Netherlands	0.985	0.816	0.999	0.166	1.020	0.923
New Zealand	1.029	0.754	1.051	0.134	1.068	0.858
Norway	0.977	0.807	0.977	0.012	1.005	0.977
Pakistan	0.744	0.362	0.803	0.004	0.829	0.437
Panama	0.937	0.603	0.965	0.213	0.963	0.720
Peru	0.868	0.803	0.861	0.124	0.880	0.958
Philippines	0.804	0.577	0.825	0.238	0.844	0.675
Portugal	0.959	0.814	0.960	0.185	0.981	0.948
South Africa	0.972	0.626	1.005	0.147	1.028	0.721
Spain	0.928	0.821	0.931	0.326	0.947	0.914
Sri-Lanka	0.814	0.686	0.827	0.588	0.833	0.706
Sweden	0.930	0.581	0.966	0.021	0.989	0.772
Switzerland	1.039	1.051	1.018	0.111	1.037	1.198
Syria	0.978	0.872	0.977	0.108	1.002	0.992
Tanzania	0.977	0.765	0.989	0.233	1.013	0.889
Thailand	0.897	.774	0.891	0.130	0.918	0.939
Trinidad	1.015	0.876	1.020	0.364	1.035	1.026
Turkey	0.952	0.904	0.943	0.265	0.961	1.000
United Kingdom	0.95[illegible]	0.796	0.962	0.405	0.975	0.891
United States	1.00[illegible]	0.815	1.027	0.596	1.040	0.862
Uruguay	0.796	0.730	0.800	0.427	0.809	0.776
Venezuela	0.910	0.603	0.939	0.043	0.966	0.726
Yugoslavia	1.011	0.851	1.020	0.111	1.041	0.951
Zambia	0.893	0.720	0.905	0.326	0.916	0.787
Zimbabwe	0.956	0.698	0.972	0.023	0.994	0.834

Pooled, Country Results

13. As the policy variable is unitless, it is possible to pool the data over all commodities for all years. The estimates of the elasticity b for the pooled data appear in column 1 of Table 1. The elasticity varies between 0.715 and 1.208 with a median of 0.945. The values for 35 out of 58 countries fall in the range of 0.9-1.0. The implication is that π, the elasticity of domestic prices with respect to the policy variable, has a median value of -0.055 (1 minus 0.945) which is indeed very small.

14. The conclusion is that world prices are transmitted to domestic prices. This is a qualitative finding. The quantitative aspect is related to the importance of such transmission. It is to be noted that in all regressions the values of R^2 are quite high. This indicates not only that world prices are transmitted, but that they also constitute a major component of the variation of domestic prices.

Decomposition by Sources

15. The policy equation (3) assumes a uniform policy for all commodities and all years. This assumption may be too strong and should therefore be examined. This can be done by generalizing (3). This is done by first assuming that the policy varies by commodity. In this case, the assumption $E(p^*v) = 0$ made in (3) is violated. Therefore (3) is rewritten:

$$z_{it} = \pi'_0 + (\pi + \pi_i)p^*_{it} + v'_{it} \qquad (3i)$$

where $E(p^* v') = 0$, and $\text{cov}(\pi_i P^*_{it}) = 0$, for all t.

The error term, v', is now defined in accordance with (3i) and, therefore, it is assumed to be orthogonal to p^*. The extension in (3i) allows for a commodity-specific deviation, π_i. A direct way to estimate the importance of this extension is to compute the between-commodity regression. Letting

$p_{.i} = \frac{1}{T} \Sigma\, p_{it}$, the commodity-price average over time, the between commodity regression coefficient is:

$$b(i) = \Sigma\, p_{i.} p^*_{i.} \;/\; \Sigma\, p^{*2}_{i.} \qquad (4i)$$

$$E[b(i) - 1] = \pi + \Delta(i), \qquad (5i)$$

where $\Delta(i)$ is a weighted average of π_i, so that

$$\Delta(i) = \Sigma \pi_i \lambda_i, \text{ and } \lambda_i = (p^{*2}_{i.}) \;/\; \Sigma\, (p^{*2}_{i.}). \qquad (6)$$

The values obtained for b(i) appear in column 5 (between i) of Table 1. The differences between these results and the pooled results are negligible. The median is 0.975, as compared with 0.945 for the pooled regression. Thus, roughly speaking, the average value of π_i is 0.03. It can then be concluded that either π_i are generally small, or else they differ in signs and therefore their weighted average is nearly zero. We return to this below.

16. A similar analysis follows for an alternative specification which allows for systematic variations of policy overtime. In this case,

$$z_{it} = \pi''_o + (\pi + \pi_t)\, p^*_{it} + v''_{it}, \qquad (3t)$$

where $E(p^*v'') = 0$ and $\text{cov}(\pi_t, p^*_{it}) = 0$ for all i.

Defining $p._t = \frac{1}{I}\sum_i p_{it}$ as the commodity-average price, the between-time regression, with variables again written as deviations from their means, is:

$$b(t) = \Sigma p^*_{.t}\, p^*_{.t} \;/\; \Sigma p^{*2}_{.t} \qquad (4t)$$

and

$$E\,[b(t) - 1] = \pi + \Delta(t), \qquad (5t)$$

where $\Delta(t) = \Sigma \pi_t \lambda_t$, and $\lambda_t = (p^{*2}_{.t}) / \Sigma(p^{*2}_{.t})$, a weighted average of π_t.

17. The results are reported in column 6 of Table 1. There is now a larger spread in country results. This may reflect the fact that the sample consists of eleven years only, and therefore the estimates of the between-time regression are less precise than those of the between-commodity. Nevertheless, for most countries the results do not differ much from the pooled regression. The median value of b(t) is .905. Consequently the average estimate of π_t is approximately -0.04, similar in magnitude and sign to that of π_i.

18. The policy equation can now be extended to allow for both commodity and year effects. Combining 3i and 3t:

$$z_{it} = \pi'''_o + (\pi + \pi_i + \pi_t)^* p_{it} + v'''_{it} \qquad (3it)$$

where $E(p^* v''') = 0$; $\text{cov}(\pi_i, p^*_{it}) = \text{cov}(\pi_t, p^*_{it}) = 0$, for all i,t.

19. Finally, an interaction term, $\pi_{it} p^*_{it}$, can be added to z_{it}, with the assumption that the covariance of π_{it} with p^*_{it} is zero. This will add additional terms to the expectations of the two between-regressions. However, in the present case, this addition is quantitatively unimportant, as we shall see below.

Technical Digression

20. The foregoing analysis differs somewhat from more familiar forms of analyzing panel data. We therefore turn now to evaluate the results within a uniform framework. The reader who is interested only with the empirical results can skip this discussion and move directly to the next section. Let W, B(i), B(t), W(i), and W(it) be projection (symmetric and idempotent) matrices that generate residuals. They can be defined in terms of their operation on an arbitrary vector x of order IT:

$$Wx = (x_{it} - x..),\ B(i)x = (x_{i\cdot} - x..),\ B(t)x = (x_{\cdot t} - x..),$$

$$W(i)x = (x_{it} - x_{i\cdot}),\ W(t)x = (x_{it} - x_{\cdot t}),\ W(it)x = (x_{it} - x_{i\cdot} - x_{\cdot t} + x..)$$

The bracketed parentheses contain the typical elements of the vectors in question. The following identities can then be derived.

$$W = W(i) + B(i) \tag{7a}$$

$$= W(t) + B(t) \tag{7b}$$

$$= W(i) + W(t) - W(it) \tag{7c}$$

$$= B(i) + B(t) + W(it) \tag{7d}$$

21. Let p and p* be the vectors of the two prices, then the regression coefficients obtained above can be derived from:
$a = p^*Ap / p^*Ap^*$. When A = W, B(i), B(t), the resulting estimators are b (pooled), b(i) (between commodity) and b(t) (between time) respectively. Also, when A = W(i), W(t) and W(it), the coefficients can be referred to as: within commodity, w(i), within time, w(t), and within time and commodity, w(it), respectively. Let A and C be two arbitrary matrixes and define:

$$r(A/C) = p^*Ap^* / p^*Cp^*. \tag{8}$$

It then follows that:

$$b = r[B(i)/W]\ b(i) + r[B[t)/W]\ b(t) \tag{9}$$

$$+ [1 - r[B(i)/W] - r[B(t)/W]\ w(it)$$

where, in view of (8), r[B(i)/W] and r[B(t)/W] are the ratios of the between commodity and between time variances to the total variance of p* respectively. Table 2 presents a decomposition of the sum of squares of p* by sources. As p* is world price, the sums of squares should be the same for all countries. However, the set of commodities analyzed varies somewhat between countries and therefore the numbers in the table differ accordingly. Taking Argentina as an example, r[B(i)/W] = 481.5/562.8 = .856, r[B(t)/W] = 69.8/562.8 = .124. Thus, the between commodity variance dominates the other components. Also note that 1 - r[B(i)/W] - r[B(t)/W] = .02, implying that there are hardly any variations left in the world prices after the time and commodity effects were eliminated. Consequently, using the values in Table 1, it is possible to approximate the pooled regression with .856b(i) + .124b(t) = .954, as compared to the actual value of .966 for the pooled regression. The difference is due to the interaction term that was neglected. It then follows that under the present framework, the expected value of the pooled regression is:

$$E[b - 1] \approx \pi + r[B(i)/W]\ \Delta(i) + r[B(t)/W]\ \Delta(t) \qquad (10)$$

that is, the deviation from 1 (perfect transmission) consists of an overall deviation (π), and a weighted average of commodity effects and time effects, and they are all relatively small.

22. Table 1 also reports the within estimators. Allowing for commodity effects yields the within commodity estimate (column 2). Their median value is about .78 which is somewhat lower than that of the pooled regression. Allowing for time effect results in the within time estimates (column 3) with

Table 2: SUM OF SQUARES OF WORLD PRICES

Country	Pooled (1) (Total)	Within (2) (i)	Within (3) (t)	Within (4) (it)	Between (5) (i)	Between (6) (t)	Check 1 (7)
Argentina	562.8	81.3	493.0	11.5	481.5	69.8	0.0
Australia	511.0	75.1	446.6.	10.6	436.0	64.5	0.0
Austria	426.4	57.2	373.2	7.7	370.4	53.4	-0.3
Bangladesh	401.2	62.9	349.3	11.0	338.3	51.9	0.0
Belgium-Lux.	414.7	58.9	358.6	9.2	357.6	56.8	-0.7
Brazil	576.0	91.8	499.3	17.5	483.6	77.0	-0.3
Burundi	385.4	46.1	346.8	7.5	339.3	38.6	0.0
Cameroon	475.8	63.6	418.7	13.0	413.0	57.9	-0.8
Canada	370.0	53.1	323.6	6.6	316.9	46.4	0.0
Chile	386.1	68.8	325.1	9.8	318.7	61.1	-0.1
Colombia	538.3	82.3	469.5	13.5	456.1	68.8	0.0
Costa Rica	442.4	59.2	390.4	11.5	384.1	52.4	-0.4
Cyprus	363.2	56.0	310.7	7.8	309.8	53.0	-0.4
Denmark	297.1	48.5	249.5	7.9	250.9	48.3	-0.8
Ecuador	542.9	83.4	473.6	14.1	459.5	69.3	0.0
Egypt	369.1	75.3	304.4	10.6	293.8	64.7	0.0
El Salvador	457.3	64.7	401.3	12.5	393.2	56.5	-0.4
Finland	273.2	39.6	235.3	6.2	235.0	38.4	-0.4
France	459.2	69.2	399.2	9.9	388.7	60.1	-0.1
Germany	429.8	55.6	375.0	10.3	371.9	56.7	-2.0
Greece	507.6	78.5	439.7	10.9	427.6	68.0	-0.1
Guatemala	437.6	58.9	386.1	11.2	379.2	51.9	-0.4
India	519.8	84.0	449.0	15.1	436.6	70.9	-0.1
Ireland	296.2	35.1	268.1	5.8	268.5	28.1	-0.1
Israel	404.6	72.5	338.3	10.9	330.5	67.1	-0.7
Italy	453.3	84.5	377.8	11.0	370.0	75.6	-0.1
Japan	562.8	78.4	494.6	12.6	486.5	68.3	-0.1
Kenya	430.2	70.3	471.1	12.9	459.8	59.2	-0.1
Korea, Rep.	482.4	63.0	425.1	7.8	424.7	57.7	-0.4
Malawi	375.8	50.1	334.7	9.0	325.8	41.1	0.0
Malaysia	446.4	58.2	394.3	13.1	390.3	53.0	-0.9
Mauritius	301.9	36.0	272.1	6.3	265.9	29.8	0.0
Mexico	522.9	92.6	440.5	14.8	433.2	82.8	-0.4
Netherlands	322.3	56.1	269.1	7.5	268.7	53.6	-0.4
New Zealand	400.1	51.5	355.3	6.7	348.6	44.8	0.0
Norway	274.5	38.8	236.1	6.9	234.6	39.6	-1.3
Pakistan	411.6	75.2	346.2	11.6	337.2	65.5	-0.1
Panama	320.5	40.2	286.7	8.4	280.5	34.0	-0.2
Peru	556.7	90.0	483.0	16.9	462.6	74.3	-0.5
Philippines	445.0	65.4	388.9	13.2	377.8	57.1	-1.0
Portugal	516.6	69.9	453.9	12.2	448.0	63.2	-0.5
South Africa	525.9	72.8	465.1	12.1	453.1	60.7	0.0
Spain	568.2	85.8	493.2	13.6	483.0	75.4	-0.3
Sri-Lanka	443.6	57.3	396.0	9.7	386.3	47.6	0.0
Sweden	365.1	53.2	310.5	10.7	315.1	56.4	-1.7
Switzerland	351.6	46.5	310.8	6.4	301.3	41.0	-0.2
Syria	397.4	71.8	335.9	9.7	325.6	61.7	-0.1
Tanzania	535.0	78.2	469.3	14.5	457.3	65.8	-0.1
Thailand	404.4	58.5	357.6	11.9	348.3	47.3	-0.5
Trinidad	388.6	47.6	345.3	10.9	341.8	44.1	-0.8
Turkey	455.6	78.6	387.2	10.2	377.0	68.4	0.0
United Kingdom	341.8	45.9	298.6	8.2	292.1	44.2	-1.1
Uruguay	383.0	65.0	326.5	8.5	318.0	56.5	0.0
United States	528.0	81.5	457.8	13.2	445.8	70.5	-0.3
Venezuela	420.8	64.3	367.0	11.3	355.0	53.9	-0.1
Yugoslavia	488.1	76.7	420.6	9.2	411.4	67.5	0.0
Zambia	400.9	47.8	363.6	7.6	359.7	37.3	0.1
Zimbabwe	426.0	54.1	378.8	8.8	372.0	47.3	-0.1

a median value of .955 which is almost equal to that obtained for the pooled regression. However, allowing jointly for the two effects gives very low, and in some cases even negative, elasticities. The question is what is the relationship between these various estimates. The answer is given in terms of the identities in (7a) to (7d) above. For instance,

$$w(i) = pW(i)p^* \,/\, p^*W(i)p^* = b + [b - [b(i)]\, r[B(i)/W(i)] \qquad (11)$$

and

$$E[w(i)] = (1 + \pi) - r[B(i)/W(i)]\, \Delta(i) \qquad (12)$$

To illustrate, using the values for Argentina taken from Tables 1 and 2:

$b = .9656$, $b - b(i) = -.0344$ and $r[B(i)/W(i)] = 481.6/81.3 = 5.92$. Substituting these values in (11) results in the value reported for w(i) in Table 1. 1/ Thus, the reason that the within commodity estimator differs from the pooled estimator is largely due to the ratio of the two variances in question rather than due to the difference between b and b(i). A similar expression can be obtained for w(t) and w(it). The latter is of a particular interest because of its big variance with the other estimates. To illustrate this point, write:

1/ The results are reported here with more decimal points than in Table 1. A minor discrepancy still exists due to rounding errors.

$$w(it) = pW(it)p^* \;/\; p^*W(it)p^*$$

$$= b + [b - b(i)]\, r[B(i)/W(it)] + [b - b(t)]\, r[B(t)/W(it)] \qquad (13)$$

and therefore,

$$E[w(it)] = (1 + \pi) - \Delta(i)\, r[B(i)/W(it)] - \Delta(t)\, r[B(t)/W(it)] \qquad (14)$$

Although $\Delta(i)$ and $\Delta(t)$ are relatively small, the r's are large. In the case of Argentina, $r[B(i)/W(it)] = 41.87$ and $r[B(t)/W(it)] = 6.07$, $b - b(i) = -.03443$ and $b - b(t) = .176$. Using these values in (13) gives, aside from rounding errors, the value of w(it) presented in Table 1.

Additional Results

23. As indicated earlier, $\Delta(i)$ is estimated by the difference $b(i) - b$. A reference to Table 1 indicates that, for most countries, this difference is rather small. By way of summary, the difference between the median values of b(i) and b is .03, which is small relative to the reference point of unit elasticity. This by itself does not imply that the individual $\pi(i)$s are small. They may be numerically large but of opposite signs. To shed light on this point the analysis has to be conducted for a smaller set of commodities as well as for individual commodities.

24. It is often stated that staple foods are more susceptible to intervention which insulates domestic markets from world prices. Also, commodities which are traded under some sort of cartel arrangements are

expected to show a larger gap in the variations of domestic and world prices. It is therefore of interest to analyze such commodities. Table 5 presents country results for individual commodities based on 11 observations: wheat, coffee and cocoa. For wheat, the median value is approximately 0.65, and only 8 out of the 58 countries had a coefficient smaller than 0.5. The median value for coffee is 0.68; for cocoa it is within the range of 0.84-0.93. The conclusion is that the policy elasticities for these commodities are negative, but on the whole they are modest and by and large world prices are well transmitted.

Pooled Country Data

25. There is another, not independent question: to what extent does the world price used here represent the domestic country price. This is not a trivial question. Recall that the world price is the export unit value and as such it is not an average of domestic prices. After all, world trade constitutes only a small fraction of world production. To examine this question, the regression is estimated with all countries pooled together. The analysis is greatly simplied when the sample is balanced, in the sense that there are no missing observations. As not all countries grow the same crops every year, a subsample was selected which consists of 17 commodities, 18 countries and 11 years, altogether 3366 observations. In such an analysis the individual countries serve as repeated observations, because they all face the same world price p^{*}_{it}, for commodity i in year t. The pooled elasticity for this sample is .976, with $R^2 = .729$.

Table 3: CEREALS ONLY: ELASTICITY OF PRICE WITH RESPECT TO WORLD PRICES

COUNTRY	POOLED	WITHIN			BETWEEN	
		i	t	it	i	t
Argentina	0.870	0.911	0.859	0.160	0.865	0.967
Australia	0.975	0.975	0.973	0.743	0.975	0.992
Austria	0.916	0.742	0.926	-0.045	0.932	0.799
Bangladesh	0.685	0.876	0.245	-0.084	0.268	0.908
Belgium-Lux.	0.696	0.714	0.678	0.714	0.694	0.887
Brazil	0.786	0.901	0.426	0.231	0.453	0.960
Burundi	0.682	0.686	0.684	0.830	0.675	0.680
Cameroon	0.909	1.142	0.034	0.031	0.282	1.474
Canada	0.919	0.988	0.907	-0.018	0.913	1.067
Chile	0.650	0.949	0.537	2.103	-0.336	0.704
Colombia	0.558	0.672	0.302	0.508	0.286	0.677
Costa Rica	0.572	0.596	0.543	0.646	0.509	0.592
Cyprus	0.645	0.657	0.296	0.280	0.653	0.864
Denmark	0.849	0.980	0.201	0.222	0.202	1.131
Ecuador	0.613	0.774	0.172	0.132	0.175	0.796
Egypt	0.483	0.739	-0.083	0.109	-0.098	0.761
El Salvador	0.642	0.613	0.548	0.074	0.711	0.738
Finland	0.596	0.592	0.318	0.017	0.621	0.718
France	0.812	0.751	0.814	0.108	0.820	0.798
Germany, F.R.	0.827	0.708	0.829	0.251	0.839	0.813
Greece	0.791	0.840	0.779	0.088	0.785	0.896
Guatemala	0.685	0.693	0.579	0.325	0.654	0.759
India	0.489	0.608	0.190	0.283	0.206	0.645
Ireland	0.949	0.895	0.947	0.065	0.955	0.986
Israel	0.608	0.878	-0.253	0.722	-0.533	0.881
Italy	0.630	0.708	0.378	0.096	0.396	0.757
Japan	0.908	1.227	0.863	0.063	0.870	1.312
Kenya	0.805	0.834	0.644	0.129	0.729	0.895
Korea Rep.	1.681	1.035	0.634	0.349	0.640	1.133
Malawi	0.633	0.400	1.004	-0.070	1.079	0.418
Malaysia	0.757	0.682	0.774	0.380	1.008	0.771
Mauritius	0.648	0.879	0.000	-0.112	0.011	0.917
Mexico	0.668	0.773	0.394	0.238	0.380	0.792
Netherlands	0.615	0.671	0.204	0.060	0.336	0.778
New Zealand	0.031	0.733	1.051	0.043	1.058	0.788
Norway	0.604	0.638	0.176	-0.130	0.447	0.803
Pakistan	0.246	0.311	0.221	0.741	0.077	0.262
Panama	0.371	0.583	-0.123	0.181	-0.196	0.622
Peru	0.716	0.751	0.599	0.373	0.620	0.764
Philippines	0.430	0.613	-0.016	0.190	-0.131	0.625
Portugal	0.844	0.657	0.856	0.062	0.866	0.746
South Africa	0.881	0.611	0.906	0.046	0.913	0.652
Spain	0.879	0.718	0.892	0.196	0.898	0.756
Sri Lanka	0.729	0.830	0.508	-0.136	0.547	0.864
Sweden	0.460	0.517	0.238	0.021	0.307	0.625
Switzerland	0.864	1.114	0.838	0.177	0.842	1.188
Syria	0.905	0.859	0.962	0.282	1.014	0.878
Tanzania	0.755	0.819	0.525	0.216	0.602	0.887
Thailand	0.720	0.941	0.362	1.055	0.176	0.927
Trinidad	0.648	0.738	0.223	0.121	0.343	0.836
Turkey	0.923	0.809	1.115	-0.178	1.231	0.843
United Kingdom	0.879	0.844	0.877	0.422	0.880	0.897
United States	0.925	0.909	0.925	0.749	0.927	0.914
Uruguay	0.686	0.918	0.167	0.655	0.130	0.926
Venezuela	0.666	0.755	0.475	0.164	0.496	0.777
Yugoslavia	0.922	0.807	0.930	0.807	0.936	0.846
Zambia	0.872	0.680	1.126	0.680	1.271	0.721
Zimbabwe	0.803	0.592	1.114	-0.008	1.313	0.650

Table 4: VEGETABLES ONLY: SUMMARY TABLE FOR WITHIN AND BETWEEN COEFFICIENTS

COUNTRY	POOLED	WITHIN			BETWEEN	
		i	t	it	i	t
Argentina	1.027	0.740	1.176	0.356	1.213	0.770
Australia	0.706	0.921	0.466	0.082	0.496	0.994
Austria	0.951	0.868	1.017	0.802	0.966	0.854
Bangladesh	0.551	0.468	0.573	-0.171	0.631	0.524
Belgium, Lux.	1.182	1.052	1.311	1.135	1.325	1.046
Brazil	1.319	1.294	1.270	-0.099	1.333	1.418
Burundi	0.826	0.360	1.083	0.234	1.117	0.369
Cameroon	0.988	0.906	0.993	0.114	1.033	0.977
Canada	0.657	0.697	0.587	0.193	0.619	0.742
Chile	0.977	0.539	1.350	0.277	1.434	0.561
Colombia	1.068	0.659	1.246	-0.350	1.319	0.740
Costa Rica	1.065	0.601	1.243	0.459	1.271	0.614
Cyprus	1.006	0.958	1.041	0.736	1.067	0.974
Denmark	1.223	1.136	1.292	1.092	1.308	1.139
Ecuador	1.148	0.809	1.295	0.067	1.345	0.865
Egypt	1.194	0.994	1.331	0.216	1.419	1.053
El Salvador	0.824	0.935	0.729	0.013	0.761	1.017
Finland	1.225	0.773	1.522	0.419	1.606	0.808
France	1.000	0.825	1.191	0.849	1.220	0.823
Germany, F.R.	0.840	0.944	0.769	0.610	0.773	1.048
Greece	0.964	0.844	1.035	0.234	1.098	0.890
Guatemala	1.187	0.632	1.394	-0.202	1.455	0.704
India	0.735	0.507	0.858	0.505	0.875	0.507
Ireland	0.544	0.937	0.275	0.674	0.249	0.961
Israel	0.826	0.720	0.919	0.386	0.934	0.734
Italy	0.792	0.838	0.726	0.559	0.740	0.859
Japan	1.370	1.158	1.427	-0.026	1.493	1.290
Kenya	0.553	0.475	0.566	-0.205	0.601	0.530
Korea, Rep.	0.954	1.015	0.815	-0.054	0.926	1.188
Malawi	0.433	0.309	0.462	-0.347	0.493	0.365
Malaysia	0.236	0.803	0.023	-0.490	0.038	0.918
Mauritius	1.132	1.256	1.008	-0.047	1.057	1.363
Mexico	0.898	0.661	1.005	0.031	1.099	0.762
Netherlands	1.307	1.012	1.528	0.250	1.534	1.074
New Zealand	0.207	0.544	-0.095	-0.146	-0.091	0.608
Norway	1.320	0.838	1.612	0.237	1.715	0.899
Pakistan	0.365	0.328	0.342	-0.508	0.408	0.389
Panama	0.939	0.529	1.091	0.254	1.122	0.553
Peru	0.966	0.838	0.991	-0.279	1.049	0.923
Philippines	0.930	0.676	1.054	0.681	1.071	0.676
Portugal	0.981	1.046	0.853	-0.019	0.959	1.175
South Africa	0.891	0.580	1.111	0.282	1.175	0.608
Spain	0.972	0.929	0.972	0.495	1.002	0.975
Sri Lanka	0.782	0.665	0.802	-0.182	0.847	0.741
Sweden	1.110	0.599	1.364	0.176	1.380	0.703
Switzerland	0.994	0.960	0.983	0.182	1.047	1.016
Syria	0.825	0.814	0.794	0.250	0.841	0.851
Tanzania	1.130	0.968	1.185	0.337	1.224	1.022
Thailand	0.798	0.354	0.987	-0.293	1.046	0.412
Trinidad	0.882	1.084	0.798	0.349	0.811	1.150
Turkey	0.851	0.970	0.651	0.264	0.684	1.016
United Kingdom	1.086	0.887	1.196	0.937	1.247	0.918
United States	0.596	0.832	0.375	0.270	0.373	0.909
Uruguay	0.405	0.485	0.292	-0.152	0.327	0.541
Venezuela	0.730	0.820	0.654	0.094	0.679	0.885
Yugoslavia	0.726	0.920	0.491	0.585	0.483	0.945
Zambia	0.766	0.759	0.788	1.169	0.770	0.726
Zimbabwe	0.752	0.580	0.805	-0.132	0.848	0.644

Table 5: ELASTICITY OF PRODUCER PRICES WITH RESPECT TO WORLD PRICES FOR SELECTED COMMODITIES

Country	Wheat	Coffee	Cocoa
Argentina	0.70118		
Australia	0.90514		
Austria	0.58824		
Bangladesh	0.65485		
Belgium-Luxembourg	0.62648		
Brazil	0.81396	0.65206	1.1923
Burundi	0.51779	0.67989	
Cameroon	1.15186	0.53017	0.61456
Canada	0.95447		
Chile	0.83626		
Colombia	0.62013	0.61911	0.61176
Costa Rica	0.55367	0.94008	1.07543
Cyprus	0.47708		
Denmark	0.89237		
Ecuador	0.52851	0.62852	0.97872
Egypt	0.56167		
El Salvador	0.62115	1.05404	0.92683
Finland	0.41253		
France	0.58173		
Germany	0.64565		
Greece	0.71502		
Guatemala	0.6868	0.86177	0.97473
India	0.40493	0.14221	
Ireland	0.7066		
Israel	0.82092		
Italy	0.65518		
Japan	1.11312		
Kenya	0.77996	1.00593	
Korea, Rep.	0.90314		
Malawi	0.50035	0.42954	
Malaysia	1.00846	0.83695	0.84433
Mauritius	0.69214		
Mexico	0.58558	0.85832	0.83584
Netherlands	0.58419		
New Zealand	0.70093		
Norway	0.60052		
Pakistan	0.09736		
Panama	0.49686	0.42537	1.02345
Peru	0.70418	0.73226	1.04622
Philippines	0.60916	1.01799	0.75422
Portugal	0.42215		
South Africa	0.45356		
Spain	0.5463	0.55763	
Sri Lanka	0.58647	0.80918	1.08503
Sweden	0.48239		
Switzerland	0.90987		
Syria	0.68743		
Tanzania	0.63865	0.61596	0.49762
Thailand	0.9951	0.46107	
Trinidad	0.72659	0.60366	0.70243
Turkey	0.70537		
United Kingdom	0.70782		
United States	0.95847	0.83133	
Uruguay	1.15293		
Venezuela	0.80533	0.05066	0.50441
Yugoslavia	0.62647		
Zambia	1.18678	0.71453	
Zimbabwe	0.62393	0.43381	

26. A similar analysis for subsets of commodities gives the following elasticities for the pooled regressions, with R^2 reported in the parentheses: cereals .839 (.86), vegetables .933 (.61), oilseeds, .963 (.70), fruits .700 (.70), beverages .729 (.73), fibers .719 (.73), tobacco .599 (.86), livestock, .980 (.71).

27. Turning to individual commodities, with the number of countries follow the R^2 in the parentheses, the results are: rice .692 (.83; 45), barley .770 (87; 49), maize .820 (.86; 58), rye .810 (.89; 39), oats .796 (.88; 51), millet .853 (.89; 34), sorghum .858 (.82; 45), wheat .693 (.85; 58), rubber .518 (.82; 10), sugar .199 (.87; 54).

28. A potential problem of any empirical application is that the results emerging from the study reflect the idiosyncrasies of the way in which the data are collected, estimated or reported rather than the underlying economic effects. This possibility is inherent in applied work and can never be eliminated. However, in an effort to check for results that are consistent and independent of the underlying data source, the procedure described above was repeated on a separate data set. Tables 6 through 8 report results obtained by repeating the procedure on 25 years of producer prices in the EC-10 as published by Herlihy et. al. (1989). Producer prices for barley, butter, cattle, cheese, eggs, maize, milk, oats, pork, poultry, pototoes, rice, rye, sugarbeets, and wheat are included in the data. Country coverage includes Denmark, France, Greece, Ireland, Italy, the Netherlands, the United Kingdom, and West Germany. In addition, Belgium and Luxembourg are treated as a single region. Pooled EC-aggregate results are reported, as well. The

Table 6: ELASTICITY OF PRODUCER PRICES WITH RESPECT TO WORLD PRICES FOR THE EUROPEAN COMMUNITY

Country	b (pooled)	Standard Error	T-Score	Adjusted R-Squared
Belgium/Luxembourg	0.979	0.023	42.78	0.85
Denmark	0.957	0.019	49.76	0.88
France	1.009	0.021	48.85	0.87
Germany F.R.	0.956	0.021	45.21	0.86
Greece	0.988	0.020	49.65	0.90
Ireland	0.909	0.029	30.93	0.81
Italy	0.991	0.020	49.51	0.87
Netherlands	0.935	0.022	42.96	0.85
United Kingdom	0.957	0.019	51.28	0.89
EC Average	0.967	0.007	134.16	0.86

Table 7: ELASTICITY OF PRODUCER PRICES WITH RESPECT TO WORLD PRICES (EC)

Country	Pooled (b)	Within (i)	Within (it)	Within (it)	Between (i)	Between (t)
Belgium/Luxembourg	0.97878	0.82053	0.99427	0.60137	0.99806	0.83937
Denmark	0.95745	1.05256	0.94251	0.59465	0.94586	1.09194
France	1.00919	0.77032	1.03233	0.33854	1.03891	0.80590
Greece	0.98794	0.69736	1.01723	0.40818	1.02373	0.72479
Ireland	0.90879	0.92189	0.90351	0.68266	0.90643	0.94086
Italy	0.99092	0.77990	1.01211	0.31841	1.01932	0.81855
Netherlands	0.93524	0.86246	0.94005	0.51962	0.94411	0.89194
United Kingdom	0.95680	0.93070	0.95657	0.60355	0.95998	0.95883
Germany, F.R.	0.95612	0.84528	0.96405	0.38678	0.96962	0.88471
EC	0.96737	0.85165	0.97708	0.48234	0.97838	0.88341

Table 8: PRODUCER PRICE ELASTICITIES WITH RESPECT TO WORLD PRICES FOR SELECTED COMMODITIES

Commodity	Belgium/ Luxembourg	Denmark	France	Federal Republic of Germany	Greece	Ireland	Italy	Netherlands	United Kingdom	European Community
Barley	0.71435	0.97215	0.69096	0.68419	0.63153	0.87775	0.71782	0.76180	0.86865	0.76880
Butter	0.52201	1.10116	0.60682	0.73629	0.71555		0.65394	0.87974	1.07247	0.78600
Cattle	0.95788	1.19329	0.88884	0.98713	0.82901	1.10508	0.87287	0.91107	1.02313	0.97425
Cheese	0.92142	1.28692	0.84411	1.02179	0.77285		0.83674	1.03998	1.11623	0.98000
Eggs	0.63558	0.91878	1.19786	0.78698	0.73947	0.78471	0.54785	0.76204	0.63434	0.77862
Maize			0.68343				0.85417			0.76880
Milk	1.18823	1.72128	1.23026	1.39492	0.66893	1.55054	1.39304	1.31213	1.17299	1.29359
Oats	0.77850	0.99771	0.71647	0.75335	0.74656	0.84547	0.77350	0.71949	0.81865	0.79441
Pigs	0.72207	0.81864	0.57090	0.75415		0.76728	0.64235	0.73252	0.73517	0.71788
Poultry	0.95483	0.95039	0.60383	0.87973	0.41084	0.74830	0.53365	0.93656	0.91322	0.77015
Potatoes	1.07921	1.10471	0.90602	0.90102	0.75519	1.01842	0.94985	1.01588	0.92297	0.96148
Rye	0.84387	0.91158	0.69711	0.82241	0.64540		0.84759	0.77341	1.05246	0.84759
Sugarbeets	0.74074	0.88504	0.79767	0.71826			0.62443	0.78962	0.79526	0.81790
Wheat	0.66116	0.90719	0.61932	0.72264	0.53690	0.69820	0.77443	0.67367	0.89776	0.76830

producer prices were originally reported in the domestic currency of each country. Official exchange rates as reported in the same publication were used to convert the prices to a dollar denomination. World prices were derived by dividing world export values by world export quantities as published by FAO.

29. While the country and commodity coverage available from the EC data is more limited than in the original data set, the EC data provide an interesting and robust check on the findings. EC agricultural policy is active, well-financed, and sophisticated in its execution and reporting mechanisms. Because it is well-financed, any wedge between domestic and international prices could be expected to be more long-lived than in lower-income countries.

30. The results in Tables 6 and 7 confirm the earlier results. Although the commodity coverage is different, the pooled elasticities for countries common to both samples are remarkably similar. The producer price elasticities for the EC countries in Table 1 range from 0.91 to 1.04, while the elasticities of Table 6 range from 0.91 to 1.01. The adjusted R^2s range from .81 to .90. As with the earlier results, the commodity and time effects are small. From Table 7, the median for b(i) is .978 as compared to the pooled result of .967, yielding a commodity effect (π_i) of 0.01. The absolute value of the time effect (π_t) is slighly larger at -0.08. Within commodity and time effects are reported in Table 7 as well. Again the estimated values are consistent with results from the larger data set. Table 8 provides elasticities for individual commodities. The results for wheat can

be directly compared to the results in Table 5 which were obtained from the larger data set. Again, despite different sample years, the results are fairly comparable.

DISCUSSION

31. What do the results show? By way of generalization, the deviation from unitary elasticity is, on the whole, surprisingly small; and while there appear to be some differences among commodities and commodity groupings, the results appear quite robust regardless of the manner in which the data are pooled or disaggregated.

32. The deviation from unitary elasticity is in part due to policy measures and in part due to domestic inputs which are not necessarily synchronized with world agricultural prices. 1/ This does not imply that policies generated with respect to particular products are not important in affecting the prices of these products. They certainly affect the price levels and whenever a country taxes agriculture the domestic prices will differ from world prices. However, the question which is of concern to us is not the existence of price intervention mechanisms, but rather whether or not these mechanisms move systematically with world prices. The evidence in this paper suggests that they do not.

1/ For an analysis of this subject see Mundlak, Cavallo and Domenech.

33. This brings up the next question: how about policies which are not related to world prices? These, by definition, will not bias the coefficient and a unitary elasticity will be observed. What is then the role of world prices in this case? The empirical answer is given by the degree of fit of the model, that is, by the proportion of the total variance of domestic prices which is accounted for by world prices. The values are relatively high.

34. The implication of this result is that technical change (and other shocks of a more permanent nature) which originate in one country but which are big enough to affect world prices, eventually affect prices in all countries. The passive countries, which are the shock takers, cannot avoid them for very long because it is too costly to do so. Realizing this cost limitation to an autonomous policy, it seems more reasonable to use, from the outset, resources to implement the necessary structural adjustments; including the enhancement of technical change, if this is the source of the shock, rather than to delay the process through taxation. This is certainly a very general statement and it has to be properly interpreted when it comes to a particular policy; however, it is mentioned here in order to put possible implications of the analysis within a broader framework.

35. Finally, we consider here a large number of commodities. In general, the trade of a country concentrates only in a few commodities, while trade in the others may be totally unimportant. The prices of the non-traded commodities is determined by domestic supply and demand and therefore, on the surface, should be independent of world prices. The explanation for the observed dependence is basically an extension of factor-price equalization.

The prices of the traded commodities determine the prices of the specific agricultural resources such as land, capital and labor in the country.

36. To conclude, even though domestic policies affect prices, they cannot prevent the covariations of domestic prices with world prices in the long run and therefore do not change the developments caused by fundamentals. There is a simple reason for it. Price distortion is costly and public resources, just like private resources, are finite.

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